

WindEnergy with Competence and Passion >

**Offshore O&M: Challenges and Opportunities in a
rapidly changing market**

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Friedrich von Storch, Operations Manager Offshore Wind

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EnBW: company and offshore figures


One of the largest energy supply companies in Germany




 One of the **largest energy supply companies** in Germany and Europe, with **strong roots in Baden-Württemberg**. Our core business: **electricity, gas, heat and water**.


Our business segments

 We are vigorously expanding **renewable energies**.

 We transport electricity, gas and water across all voltage and pressure levels via our **grids**.

 Our **sales department** serves as contact for all energy-related issues of our customers.

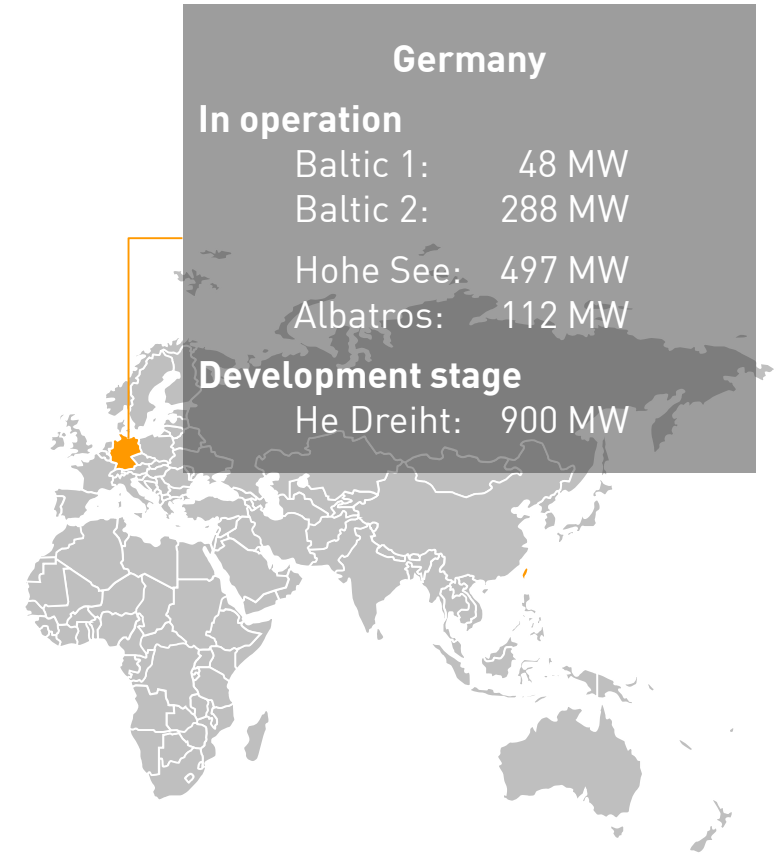
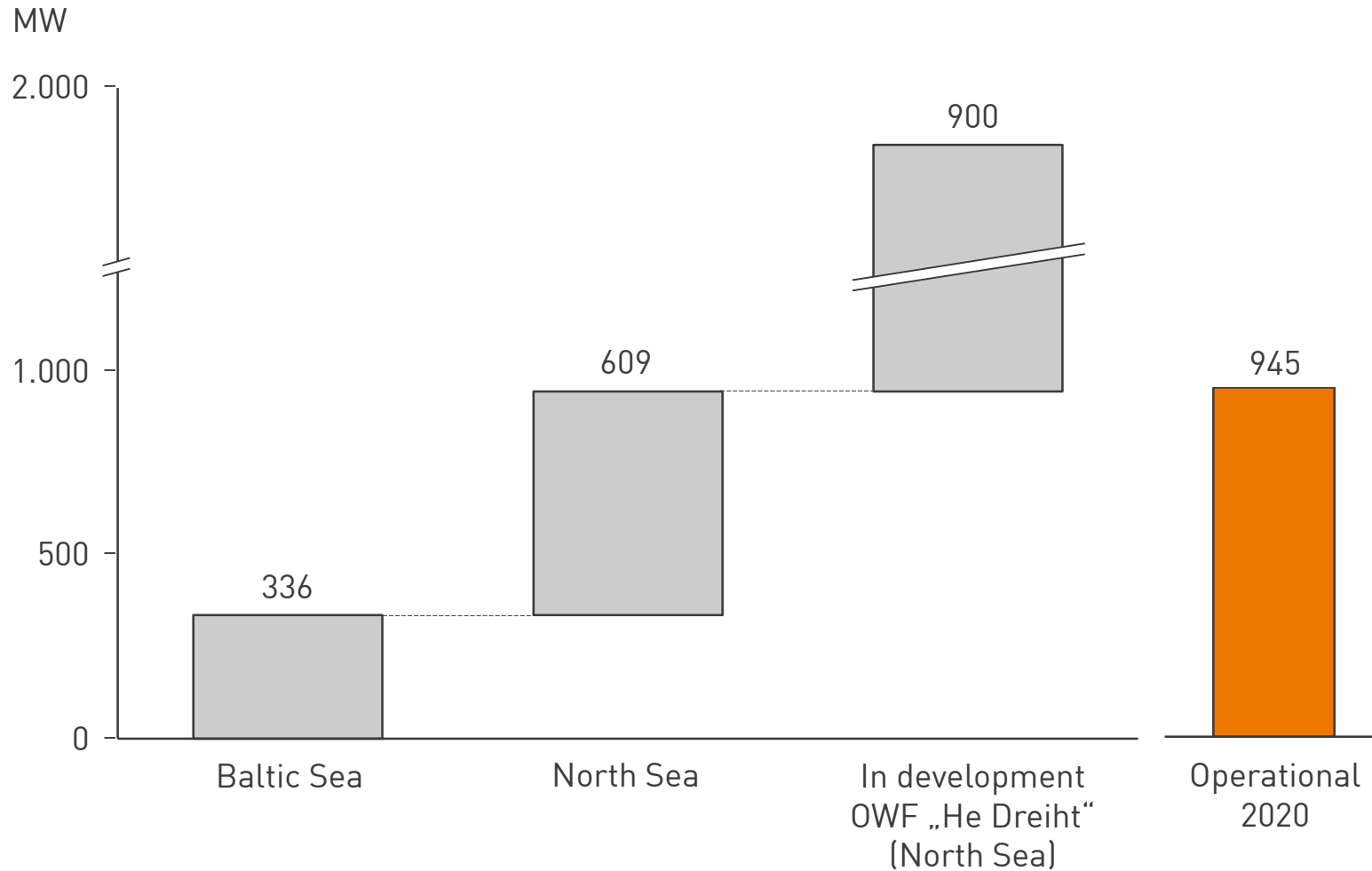
 In the **trade and generation** segment we optimise our conventional power plants in terms of economy and CO₂ and trade energy for our customers and ourselves on the stock exchange.

 We are evolving **from an energy provider to an infrastructure partner**.



EnBW: company and offshore figures

Offshore Wind portfolio: game changer “He Dreiht” first zero subsidy bid



Evolution of offshore wind

From first steps to full grown and far offshore

Baltic 1 (since 2011)

- › First offshore wind farm in the German part of the Baltic Sea
- › 21 turbines, total capacity of 48 MW
- › AC connection via OSS to mainland
- › 16 km distance to shore
- › Land based O&M setup (via CTV)
- › Single setup for logistics and personnel



Baltic 2 (since 2015)

- › 80 turbines, total capacity of 288MW
- › AC connection via OSS to mainland
- › 32 km distance to shore
- › Sea based O&M setup (via SOV)*

*only until 2020 – then CTV



Hohe See & Albatros (since 2019)

- › 87 turbines and 609 MW of installed capacity, 2 substations (largest wind farm in German waters)
- › DC connection via converter station to mainland
- › ~100 km distance to shore
- › Sea based O&M setup (via SOV and helicopter)

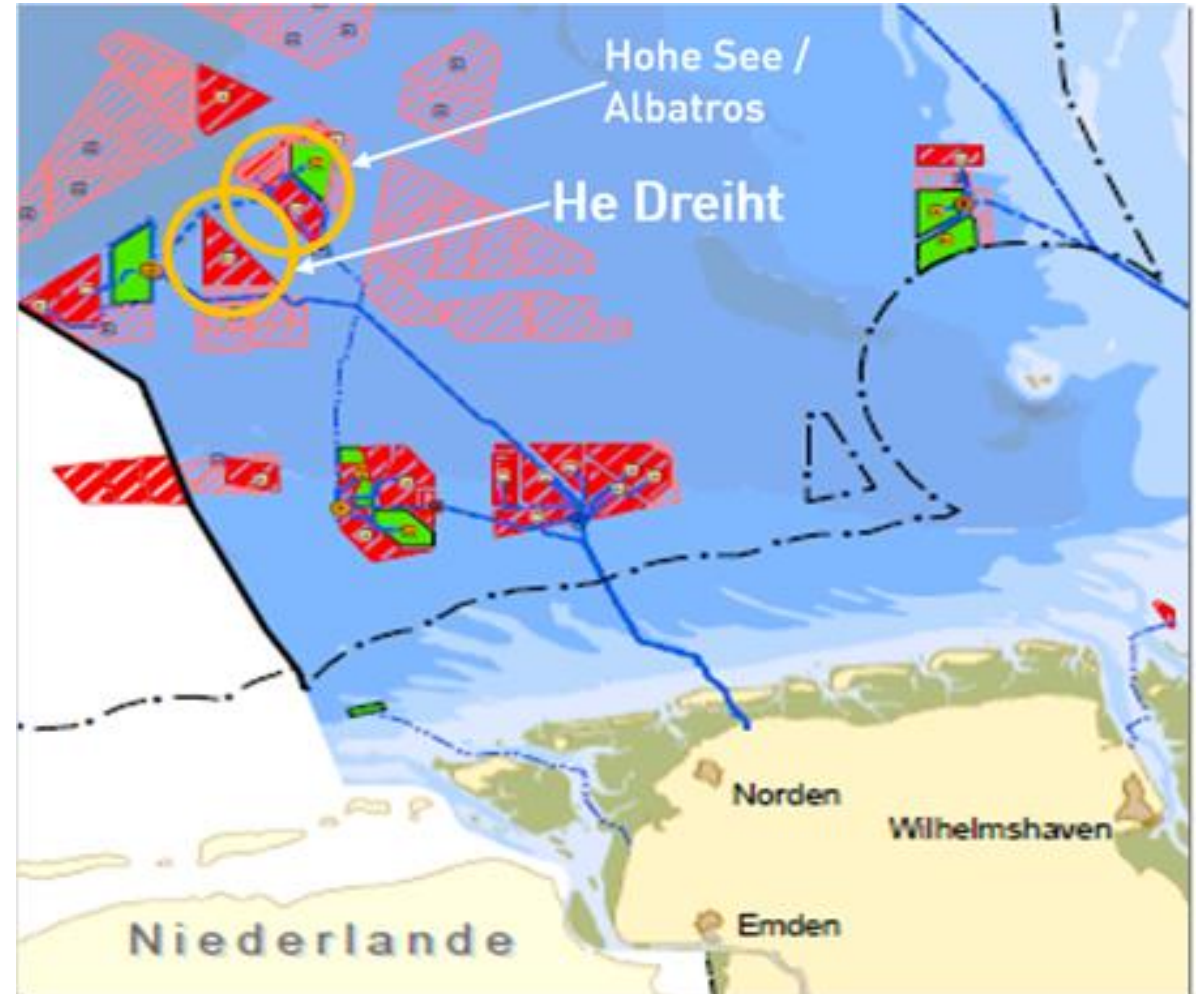


Evolution of offshore wind

Future outlook

He Dreiht (planned for 2025)

- Total capacity of up to 900 MW
- 66kV inner array cabling
- Direct connection to TSO's converter station – no inner park OSS
- Turbine size of 12+ MW (expected)
- No fixed feed in tariff
- Realization of synergies with neighbouring wind farms (Hohe See and Albatros)



What´s next?

End of “fixed tariffs era”



“Old world” with fixed FiTs

- › Fixed price for every kWh that is fed into the grid
- › “linear” O&M planning → Only focusing on wind conditions
- › Every kWh is worth the same – focus only on wind conditions
- › Main focus on park availability (time or yield based)

“New world” with variable power prices (0 ct bids)

- › Revenues are dependent on market prices / PPA conditions
- › Service activities are driven by power prices and PPA clients
- › Focus on €, not on kWh
- › Operators and service providers transform into flexible and reactive power producers

What's next?

Preparations for a fully merchant world

PPA

- > early commitment for energy price
- > physical equipment + financial modelling

Storage

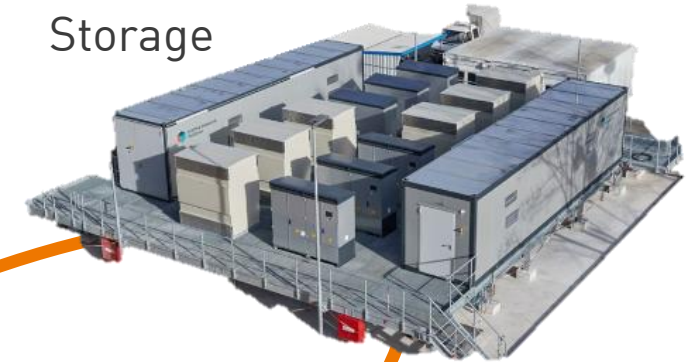
- > battery system design (JV BOSCH / EnBW)

O&M excellence

- > performance monitoring and lifetime (EnBW CMS tool)
- > fleet data exploitation (EnBW corporate venture SANDY)
- > business case modelling for overall O&M
- > Service setups across multiple wind farms



Storage



Challenges and opportunities

Implications for O&M work

Scheduled Maintenance

- › continuous improvement in team with OEM
- › high degree of automated processes/documentation
- › optimized logistics concept („collecting bus“)

Troubleshooting

- › conceptual optimization based on feed-in system
- › best possible training and online support

Two Types of „Zero Subsidy“

- › „Zero Subsidy“ applies not only for new projects
- › additional challenges „for post FiT“

VR based O&M Training

- › continuous work optimization without WTG downtime



Challenges and opportunities

New thinking for operators and service providers

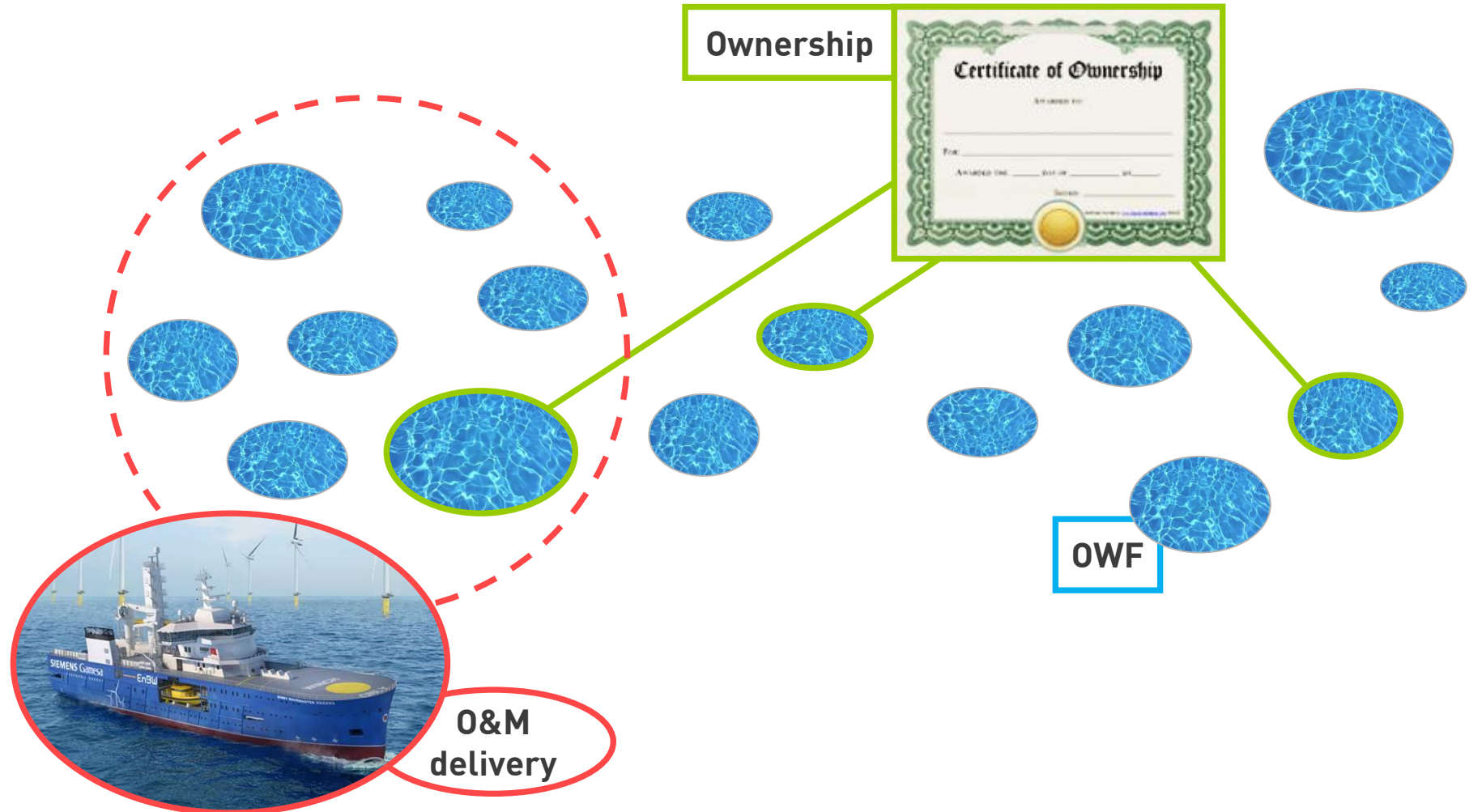
Ownership

- > random effect of auctions
- > asset clustering is difficult

O&M delivery

- > self-enforcing savings effect
- > cluster wise approach
- > collaboration of advantage
- > more flexibility and new ideas for innovative service contracts

→ **Joining forces pays**



Thank you for your attention
Questions?





Friedrich von Storch
Manager O&M North Sea Projects
EnBW AG

EnBW Energie Baden-Württemberg AG
Fischertwiete 1
20095 Hamburg

f.vonstorch@enbw.com